Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year (New format)	AY2026-2027
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Chen Xiuying
Course Author Email	xiuying.chen@ntu.edu.sg
Course Title	Physics Laboratory IIa
Course Code	PH2198
Academic Units	2
Contact Hours	49
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	PH1198 or CY1400
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to:

a. build understanding of experimentation in key topics of physics.

b. provide foundation knowledge for experimental physics

c. begin building observational skills of physical phenomena.

d. show how experiments further knowledge in physics.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Write a lab report with appropriate figures, captions, and references
ILO 2	Perform error analysis and understand the propagation of errors
ILO 3	Perform curve fitting by doing weighted or unweighted linear or nonlinear regression using softwares like Origin, Matlab or Python
ILO 4	Keep a proper lab notebook, and exercise basic scientific data management
ILO 5	Discuss deviations between theory and experiment
ILO 6	Use various experimental techniques, e.g. lock-in amplification, to reduce measurement errors
ILO 7	Use various statistical procedures to reduce irremovable sources of error, e.g. radioactive decay
ILO 8	Perform moderately sophisticated optical system assembly and alignment

Course Content

You will understand the fundamentals of proper experimentation and its importance to discovery and knowledge of physics. You will acquire skills and knowledge related to the key areas of physics.

Reading and References (if applicable)

1. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, 2nd ed, John R. Taylor, University Science Books, 978-0935702750, 1996

2. Experimentation: An Introduction to Measurement Theory & Experiment Design, 3rd ed, David C. Baird, Addison-Wesley, 978-0133032987, 1994

3. Various reference notes provided on NTULearn during the course.

NOTE: The above reading comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they are available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	Week 1: Lab Introduction Lecture	1-8	In-person	General briefing of the course structure, requirement, assessment components and lab safety related things.	
2	Week 2-11: Lab Sessions (based on assignment by Year 2 Lab manager)	1-8	In-person	Hands-on experiments, report writing and Viva with lab TAs.	
3	Week 12, 13 & revision week: Make-up lab sessions (as applicable)	1-8	In-person	Hands-on experiments, report writing and Viva with lab TAs.	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Experiment(s)' Viva Voce & Discussion	You would be asked warm-up and in-depth questions by the teaching assistant or faculty member conducting the viva. You would be tested on your depth of understanding of the various experimental aspects. You receive feedback through interactions with the teaching assistant.
Experiments Laboratory Full-Reports	You would be able to receive feedback from the markers who had graded your reports and use the feedback in the next experiment/lab course.
In-Class Assessment	During the laboratory session, you may be assessed through activities such as practical checkpoints, real-time data analysis, experimental demonstrations, short reflections, or concept-based discussions. The in-class assessment is designed to evaluate your active participation, hands-on competency, experimental decision-making, and understanding of the experiment during the actual lab session. Immediate verbal feedback may also be provided by the teaching assistant or instructor during the assessment process.
Pre-Experiments Online Quiz	Before your hands-on lab session, you will complete a short quiz via the online assignment system. The quiz serves to introduce the experiment you will be working on, and to encourage you to review the relevant lab manual and supporting materials in advance. It is designed to help you gauge your understanding of key concepts and procedures, and to ensure you are adequately prepared for the upcoming experiment. Immediate feedback will be provided through your quiz scores on NTULearn.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Report/Case study(Experiments Laboratory Full-Reports)	LO 1-8		35		Individual	Analytic	Relational
2	Continuous Assessment (CA): Assignment(Experiment(s)' Viva Voce & Discussion)	LO 1-8		40		Individual	Analytic	Relational
3	Continuous Assessment (CA): Test/Quiz(Pre-Experiment Online Quiz)	LO 2, 4, 6-8		10		Individual	Analytic	Multistructural
4	Continuous Assessment (CA): Class Participation(Experiments In-Class Assessments)	LO 1-8		15		Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

You will be assessed by an online assignment system (NTULearn) and Lab Teaching Assistants (TAs).
The shown weightage for all components is the cumulative weightage over 4 different experiments.

Formative Feedback

Formative feedback is given through multiple discussion sessions with the various experiments' teaching assistants as well as through the reports with comments.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Collaboration	Basic
Communication	Intermediate
Creative Thinking	Basic
Problem Solving	Basic
Sense Making	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Attendance for all lab session is mandatory. Students are expected to read the lab manual and related materials before attending each session. A pre-lab quiz is administered online to assess readiness and reinforce key concepts.
Safety protocols must be strictly followed at all times. Proper attire is mandatory; no food and drinks are allowed in the lab.
All data must be recorded honestly and accurately. Plagiarism, fabrication or sharing of results without permission constitutes academic misconduct.
Lab reports must be submitted by the stated deadlines. Late submission may be penalized unless prior approval has been granted.

Policy (Absenteeism)

If you are sick and unable to attend your laboratory or viva sessions, you have to:

Send an email to the lab manager regarding the absence and request for a replacement / make-up laboratory or viva session.

Submit the original Medical Certificate* or official letter of excuse to administrator.

Attend the assigned replacement session (subject to availability).

*The medical certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.

Policy (Others, if applicable)

Diversity and inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer or a peer or senior (either in-person or via email) about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

PH2198 Physics Laboratory IIa – Assessment Rubrics

The revised assessment framework is designed to provide a balanced evaluation of students' conceptual understanding, practical competency, scientific reasoning, and communication skills through a combination of pre-laboratory preparation, authentic in-class performance, written reporting, and oral assessment.

Part 1: Pre-Laboratory Quiz (10%)

- **Conceptual Understanding & Preparation:** Assesses students' understanding of key theoretical concepts, experimental objectives, apparatus, procedures, safety requirements, and expected data analysis methods prior to the laboratory session.
- **Readiness for Experiment:** Assesses students' preparedness to conduct the experiment effectively through prior review of the laboratory manual and supporting materials.
- **Feedback for Learning:** Immediate feedback is provided through the online quiz system to help students identify knowledge gaps and areas requiring further preparation.

Part 2: In-Class Assessment (15%)

- **Hands-on Experimental Skills:** Assesses students' competency in operating equipment safely, setting up experiments correctly, and performing measurements independently.
- **Real-Time Problem Solving & Decision Making:** Assesses students' ability to troubleshoot experimental issues, make informed decisions, and respond appropriately to unexpected observations.
- **Active Participation & Engagement:** Assesses preparedness, initiative, teamwork, and active participation throughout the laboratory session.
- **In-Class Data Interpretation & Reflection:** Assesses students' ability to analyse experimental observations, interpret preliminary results, and reflect on the outcomes during the laboratory session.

Part 3: Laboratory Full Report (35%)

- **Introduction, Theory & Procedure:** Assesses the clarity of experiment objectives, understanding of theoretical background, completeness of procedures, and consideration of experimental uncertainties and improvements.
- **Results:** Assesses the presentation, organisation, accuracy, and completeness of experimental data, calculations, uncertainties, graphical analysis, and curve fitting where applicable.
- **Discussion:** Assesses the student's ability to interpret results, relate findings to theory, evaluate uncertainties and limitations, analyse sources of error, and propose improvements.
- **Conclusion:** Assesses the effectiveness of the summary of findings, evaluation of experimental objectives achieved, and identification of key limitations or improvements.

Part 4: Viva Voce & Discussion (40%)

- **Experiment Theoretical Understanding:** Assesses the student's understanding of the physical concepts, principles, and scientific significance underlying the experiment.
- **Understanding of Experimental Methodology:** Assesses the student's understanding of the experimental setup, instrumentation, procedures, data acquisition methods, and troubleshooting approaches.
- **Analysis of Experimental Data:** Assesses the student's ability to interpret data, identify trends, justify conclusions, evaluate uncertainties, and support experimental deductions using appropriate evidence.
- **Communication Skills:** Assesses clarity, confidence, responsiveness, and ability to engage in meaningful scientific discussion with the instructor.